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ABSTRACT

Perhaps one of the tragedies of our time is the belated recognition of the importance of technology in the affairs of man. Technology has been and continues to be a powerful force in society. It has changed the way man lives, the way he thinks about himself and others, and his perceptions of the future. We are discovering that continued development of technology has brought about subtle, cumulative, and pervasive changes in both our natural and social environments. And it is these changes which will force reconsideration of the mission of education, including industrial arts. At issue will not be short range consideration of job or career education, but the far more serious and critical issue of the stewardship of society and the spaceship earth. The central problem of our time and the issue which should have the greatest impact on industrial arts education is the search for alternative technologies which meet the needs of human beings and enhance the quality of life in all its dimensions. The problem must be recognized as primarily social and not technological, requiring appropriate social tools to enable human beings to achieve the goal of a humane society meeting human needs and human purposes. (Author)

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- Technology -

Its Impact on Industrial Arts Education

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May 12, 1975

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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The fact that you have asked me to speak on the question of Technology and its impact on industrial arts education is evidence that there is an awareness about technology and its impact already. I am sure each of you can cite instances of where technology has affected the field of education we call industrial arts, if not directly, certainly indirectly, through its impact on your own life.

Perhaps one of the tragedies of our time is the belated recognition of the importance of technology in the affairs of man. Technology has been and continues to be a powerful disruptive force in society. Throughout the history of humankind on this planet, technology has been the single most powerful change agent. It has altered the way man lives, the way he thinks about himself and others, and his perception of the future.

Change in a technological society is thus a constant. Everything is in process. Nothing stays still. All parts are interrelated. We are dealing with a complex dynamic

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system of which we have little knowledge or understanding.

We are all aware of changes in technology. And we are all aware of changes in our society. Many of us can cite specific instances of new devices and new ways of doing things that are the result of a new technology. We know today that our choices and potential are totally different from those of our mothers and fathers. In the field of industrial arts, we can cite many changes in technology that relate directly or indirectly to the tools, materials and processes we teach about. A brief review of recent literature in the field of technology identifies terms and phrases that describe the new technology and its implied and potential impact on a field of study dedicated to the study of industry and technology. Some of the terms and phrases mentioned frequently in the literature were:

Numerical control, Interactive graphics, Fluidics, wind power, space shuttles, Geothermal energy, video discs, solar cells, negative feedback, microwave ovens, dial-a-ride, oceanic thermocline, collision avoidance systems, transponders, participatory technology, biomedicine, alternative communities, intermediate technology, coal gasification, breeder reactors, laser fusion reactor, L.E.D.'s (light emitting diodes), Acousto-optics, integrated optics, waste disposal, microwave communication channels, magnetohydrodynamics (MHO), Technology assessment, fuel cells, linear induction motors, garnet lasers, containerization, technological forecasting, controlled environment greenhouses, ACT (air traffic control), long

range satellite earth terrain cameras, Stirling powered external combustion engines, tidal power, hydrogen fuel, fuel injection, electronic ignition, climate stabilization, project Sanguine, ERTS, data networks, land use policy, computer-managed parts manufacture, SI metrics, Opaque-2 (corn), CPU's, LSI's (large scale integrated circuits), FET (Field effect transitor), MOS (metal oxide semiconductor), Supercritical wing, methanol, ozone, vinyl-chloride, technology utilization, technology transfer, genetic intervention, microcomputer, RAM (random access memory), ROM (Read only memory), DABS (Discrete Address Beacon System), CVCC (Compound Vortex Controlled Combustion), cable television, video tape cassetts, video magazines, industrialized housing, VTOL, STOL, V/STOL, biodegradation, and holography, among others.

Certainly there are potential impacts, both direct and indirect, for the field of industrial arts within each of the categories implied by the above terms and phrases. This is particularly so if we consider the first part of a generally accepted definition of industrial arts.

> Those phases of general education which deal with industry--its organization, materials, occupations, processes, and products--and with the problems resulting from the industrial and technological nature of society. (Wilber, p. 2)

What seems to be taking place is a belated recognition of the all pervasive force of technology in society. Over the years industrial arts education has, with few exceptions, concentrated on the first part of the definition, on the tools

and processes, and ignored the problems resulting from the industrial and technological nature of society. Because of this, the real impact of technology on industrial arts may raise the question about our raison d'etre, as an educational effort. And rightly so! Why? Because of the secondary and tertiary effects of technology. What we are discovering is that our spaceship earth is a delicately balanced entity of finite proportions. We are discovering that continued development of technology has brought about subtle, cumulative and pervasive changes in both our natural and social environments. And it is these changes which will force reconsideration of the mission of education, including industrial arts. At issue will not be short range consideration of job or career education, but the far more serious and critical issue of the stewardship of society and the spaceship earth.

During the last thirty years at least five major trends of global concern have developed as the result of continued technological development. (Meadows, Limits of Growth)

1. accelerating industrialization
2. rapid population growth
3. widespread malnutrition
4. depletion of non-renewable natural resources
5. deteriorating environment

These trends, all interrelated, have created a new and different kind of awareness about technology. The new awareness comes about because of the magnitude of the impact of changes in society and secondly, because of a number of predictions of the irreversibility of the trends. (Watt, p. 56)

This new awareness has brought with it the realization that doing essentially more of what we have already done, only more so, will not solve the problem. There must be other ways. Over the last several decades there has been much action, much doing, but little attempt to understand the technological and social systems so as to manage them to meet human needs.

In our present system, we operate largely from ignorance. We know little about the past with respect to technology and technological systems and their impact on society, and we know or care little about the future as inevitable as it is. Mostly we operate day to day in the eternal present hoping that someone is concerned about the future and is steering the spaceship earth.

What we know about the recent past is focused primarily on an ever increasing material standard of living, a standard of living that is based on a capital intensive and energy intensive technology. We seem to have developed a technology which has built within the system self destruct elements.

Several factors have surfaced which have been identified as the elements which are critical variables in the self destruct equation. They are:

1. Growth, including an ever accelerating industrialization and an exponentially expanding world population,

and

2. Energy Utilization. With an ever accelerating industrialization there has been a proportional increase in energy use. The level of sophistication of technology is directly related to energy consumption. The higher the level of technological development in a given society, the higher the energy consumption per capita.

These two factors, coupled with other factors, such as individual resource ownership and a growth mentality, have set the stage for a crisis of major proportions, given the present direction of technological innovation.

Population growth, coupled with a higher standard of material living bring about higher levels of environmental pollution, an accelerating depletion of natural resources, and eventually, malnutrition resulting from decreasing food supplies.

The issues can be placed in sharper focus with some data and examples.

Growth

Until recently economic growth had been accepted as a positive value. The mentality has been that more was better. Expanding population, utilizing an ever more powerful technology, exposed the danger of this mentality to industrial civilization. The critical variable was and is the expansive power of technology. And the critical question today is whether an expanding population (3.6 billion in 1970 compared to a 1.0 billion population in 1798), coupled with an acceleration of industrialism throughout the world, can be sustained. The prediction is that there are limits; that the population (projected to reach 40 billion by 2070) will eventually outrun the potential and projected food supply and industrialization will be limited due to the limits of natural resources and energy.

There are of course those who posit that demographic transition will alter the equation and limit the growth of population. Demographic transition is the theory that birth rates decline as the material standard of people is raised. The theory is based on the experience of Western nations. The general pattern is as follows.

> Before development begins, the population is stable at a low level because both birth and death rates are high. In the developing period, the death rate falls dramatically, chiefly because of the impact of medical and public health measures, but the birth rate stays high. The result is a rapid growth in population. In the developed stage the birth rate falls to a point where it is again in balance with the death rate and the population is stable at a high level. (Gould #3, p. 6)

This theory, of course, raises questions. For instance, how high does the population go during the intermediate stage? Does the population reach a level capable of being sustained, in terms of food, energy, and a standard of living comparable to the Western World today? The danger may not be the population level primarily. The danger may be that a given population level, coupled with a given level of technology will reach a critical mass. When a certain level of both population and technology is reached, deterioration sets in if economic growth is continued. The ultimate limit, however, is not numbers of people, or the availability of food supplies or resources. The ultimate limit to industrial activity is determined by the amount of heat the ecosphere can absorb. (Wade, p. 598)

Thus, with continued development of energy intensive industrialism, the prediction is that serious climatic problems will be encountered in the future. Robert Heilbroner notes that if the rate of increase in energy use were to continue at 4 percent per year, the atmosphere would begin to warm up appreciably, by some 3 degrees in 150 years, setting off all sorts of environmental catastrophies. The real need, then, is to limit industrial growth before critical mass is reached.

Energy

The United States consumes more energy on both an absolute and per capita basis than any other country. In 1971

the total energy produced in the United States was on the order of 57,000 trillion Btu's. It is projected to rise to 92,000 trillion Btu's by 1985. (Commoner, p. 22) To meet these needs will require huge investments because energy production is capital intensive. This means that large sums of money are required to create energy production systems. Commoner believes that if the trend in energy utilization continues, together with continued inefficient energy utilization, that energy production will consume an increasing fraction of the capital available for investment in new enterprises including factories, homes, schools and hospitals. (Commoner, p. 27)

The energy equation is central to the question of the quality of life in the near and distant future. If the energy problem is not solved, all else fails, for modern technology, as we know it, is energy intensive. And the production and use of energy are at the base of the problems of growth associated with a deteriorating environment and the depletion of non-renewable resources.

The answer, perhaps the only answer, seems to be two fold. One possibility is to alter our life styles, to reduce the consumption of energy. The other possibility is to redesign our technology, to search for a technology that is less energy intensive and to search for new and alternative forms of energy which are non-polluting and not capital intensive.

The latter can be accomplished by turning to income fuels including solar, wind, water and geothermal. Currently these sources of energy contribute less than 4 percent of the total production of energy. Predictions are that in the future, these sources and others will have to contribute 70 to 90 percent of our energy needs. (Cornish, p. 277)

The prognosis is not good however. Funding for the recently created Energy Research and Development Agency (ERDA) indicates that the largest budget component will be for nuclear weapons production and development. The next largest is for the civilian nuclear program, including the breeder reactor. Coal research and development are targeted for only about 10 percent, conservation of energy programs 3 percent and income energy sources such as geothermal and solar about 1 percent. (Abelson, Science, 28 July 1974) This is truly an incredulous stance for Congress to take at this time given the seriousness of the energy problem. Perhaps Hueckel (p. 927) is correct when he states that societies tend to adopt technologies that are compatible with the existing resource endowment. Hueckel, utilizing the historical record, claims:

> ...when that resource endowment changes; as existing supplies of nonrenewable resources are depleted, the techniques in use are adapted to that change through the utilization of new methods of extraction and exploration, through the introduction of substitutes for the resource whose supply is diminished, or through the application of techniques to improve the efficiency of that resource in use. (p. 927)

The question is, "Will there be time?"--time to develop the new technologies and time to create new social mechanisms for social control. What is at issue is that the lead times for the creation of new and alternative technologies, as well as new and alternative social mechanisms, become greater and greater the more sophisticated each becomes.

The critical variable at this juncture seems to be social control. Man's command over natural processes and forces far exceeds his techniques for social control, including planning and decision making.

Mankind may be awakening to the need for action. Recent research indicates a slackening of public approval for new technologies. There is more questioning. Technological progress is no longer accepted as good. There is reported a distrust in the way power holders manipulate the world; concern over maldistribution of resources; anxiety about the ethical implications of further technological advances in some areas of medicine and the biological sciences; and growing awareness that much scientific research lacks social relevance. (LaPorte, p. 121)

The public is becoming more and more aware of problems associated with the use and application of technology. Included is the growing realization that:

1. Work in a high technological society can kill. (HEW estimates that 100,000 U. S. workers die each year from occupational diseases.)

2. Inappropriately applied technology can destroy people and environments. Witness the inappropriately applied deep well technology in the Sahel. There was no social control and the nomads, carried away by the promise of unlimited water, forgot about the Sahel's limited forage. Centuries-old tribal agreements which apportioned just so many cattle to graze just so long in certain locales were ignored. Herds were increased, over-grazing resulted and each well became the center of a desert of its own. (Atlantic Monthly, May 1974)

3. The social costs of the automobile are becoming excessive whether one considers the pollution factor, the energy problem or the fact that 200,000 people were killed in automobiles in 1972 creating great losses and increasing capital investments in the form of hospitals and rehabilitation centers, among others.

4. The products of technology, designed from an economics, rather than from a human or social point of view, have built in

hidden social costs. Witness the planned obsolescence of the American automobile and the new American Ghettos created by the "Mobile Home Revolution."

Searching for Answers

For years mankind accepted technological growth and development as inevitable. Inventions and new developments were supposedly largely luck. Not so today! In growing numbers mankind has discovered that technology can be influenced by human beings. Mankind is gradually beginning to realize that the principal limitations to developing new or alternative forms of technology are not technological constraints, but rather, our own human conceptualizations of the way things can and should be.

Analysis of the past 200 years during the industrialization of the Western World indicates a certain spiritual emptiness with regard to man asserting control over his own destiny. This point of view has resulted in a few making choices for the many. This fact has considerable importance with respect to technology. Holloman (p. 10) notes that the technology employed in a given society depends markedly on that society's particular cultural and political framework, on its resources, values, and myths. This fact has been known for some time by those who have studied social and technological systems. Leslie White, in his work

The Science of Culture, 1949, discussed the same point and in addition showed the interrelationship of society and technology.

> Every social system rests upon and is determined by a technological system but every technological system functions within a social system and is therefore conditioned by it. (p. 382)

This being true, the central problem of our time and the issue which I believe should have the greatest impact on industrial arts education is the search for alternative technologies which meet the needs of human beings and enhance the quality of life in all its dimensions.

And since developments do not begin with new devices, but with people and their education, organization and discipline, I suggest we in industrial arts education dedicate ourselves to the education of the human mind and spirit for the purpose of creating on this earth the most humane existence ever. The options are ours. And it is the human mind that will make the difference. Our challenge is to exercise our humaness. And we are human, according to Rene' Dubos,

> to the extent that we are able and willing to make choices that enable us to transcend genetic and environmental determinism, and thus to participate in the continuous process of self-creation which seems to be the task and the reward of humankind. (p. 80)

Two factors stand out in Dubos' description of being human. One concerns ability, the other willingness to make choices. The first is of the mind. The second is of the spirit. Both are necessary components of the educated person of the future.

What does all this mean? Essentially it means humankind has a choice. Doomsday is not inevitable. It is possible, even probable, but not inevitable. The golden age for humankind can come about, but only if we make radical changes in our behavior as stewards of the spaceship earth.

Who are we? Why are we here? Where are we going? These are the great questions that still call out to be answered. These are the questions the answers to which will provide us with direction for the future, an operating base, a philosophy. Trite? Perhaps so. But one only needs to recall the immediate and not too distant past to observe the results of concern for power without a philosophy. On October 1, 1972, the New York Times published an editorial which points up the issue of philosophy, goals and leadership. The lead paragraph sets the stage.

The Leadership Issue

> The overriding consideration in this Presidential campaign is what may be called the leadership issue. As we noted Thursday in our editorial endorsement of Senator George McGovern for the Presidency, The Times believes that President Nixon has failed to lead the American people with any sense of moral purpose toward the broad social, economic and political goals of this American democracy. Despite some major accomplishments, this Administration has appeared to govern during most of the past four years not with any evidence of inner conviction and outward vision but rather with a mixture of opportunism, insensitivity and confusion of aim.

If we are to operate with clear vision, we must search for the proper goals for humankind, goals that are progressive

and promote human values. We must also search for means to attain these values once determined. In addition, we must find the means to control and manage the process once determined. Each of these steps will involve new and alternative forms of technology. The difference being that the choice will have been made to direct and control the means, technology, to promote human values.

Again, there are implications for education. A society's capacity to make choices, to decide goals, to produce desired changes is directly influenced by the general level of education of its citizens, particularly in the basic knowledge areas of the sciences, the technologies and the humanities.

A Question of Control

Our system of technology today was not planned, has not been directed and is not controlled in the true sense of the term. Each segment of the system has developed largely on its own and is quite independent of the total. The best example of the independence of what should be a correlated interdependent system is transportation. Until recently no one seemed to care about the high energy expenditures and the built-in mechanisms which almost assure continuation of a non-integrated competitive transportation system.

Recently individuals such as J. J. Forrester of M.I.T. and others have been attempting to discover the operational behaviors of social and technological systems. The need for this kind of effort and understanding has come about only in recent times, largely as the result of the expansive power of technology. Even today, little support exists for efforts to design and gain an understanding of the complex relationship existing within the social, political, and technological systems. (Holloman, p. 21)

Interrelatedness of Systems

Continued study of social and technological systems has identified the complex nature of the interrelatedness of the systems. Myrdal, in his work in developing countries identified what he called a circular causation which to him implied that:

> if one condition changes others will change in response, and that these secondary changes in turn will cause new changes all around. The conditions and their changes are thus interrelated and interdependent. (Myrdal, p. 3)

The discovery of systems and the interrelatedness of systems is new to the mind of man. In the past decisions in all areas of life have been made as though they had no effect on other segments. Social decision making was not approached from a systems point of view as is evident in Maurice Strong's discussion of decision making and past results.

> Clearly our past decisions have not been producing the results we expected. No one consciously decided to pollute our air or waters, to produce urban squalor that afflicts so many cities, to destroy so much of our natural environment of plant and animal life, and to produce the glaring disparities between rich and poor that characterize our global society. (Strong, p. 7)

Controlling the Process

In any search for an answer to the question of controlling the industrially advanced nations in their continued overproduction, pollution and depletion of natural resources which adds to the inequities among humankind and the continued destruction of the ecosphere, one must conclude that the problem is primarily social and not technological. Therefore, the search must be not only for the means to increase the social awareness of human beings of their potential fate, but the search must also be for appropriate social tools which will enable human beings to control the systems. Unfortunately the control mechanisms are in a very primitive state of development and the mental perspective of most individuals has been shaped for many years by a viewpoint of technology and the economy which fosters aggressive attitudes toward the environment and the "triumph" of man over nature, together with a lack of ecological perspective. The central concept is growth with the insistence that growth will solve all problems. (Burhans, p. 20)

With the publication of Limits of Growth and other studies there has been a developing awareness about the problems associated with deteriorating social and natural environments. Numerous examples of social resistance can be cited as the result of the new information. Information, then, in the form of publications such as The Limits of Growth becomes a first level control device.

What seems to be happening is the development of a new form of control focused at the community level. The social resistance at the community level has resulted from the impacts of industrial and government technology on health, land use, esthetics and other aspects of community quality of life. Organized citizen opposition has been occurring throughout the Western world. In the United States, government transportation and energy programs are now persistently opposed by local communities. (Baram, p. 465)

Some forms of control attempted by citizens have not worked as well. When individuals and families responded to appeals to reduce their energy consumption by reducing their demand for electricity, the power companies asked for rate increases to make up for lost revenues, a normal reaction of an industry whose prime goal is profit and a return on investment.

There are other forms of control adapted from the physical technologies which offer promise. They operate on the principle of feedback, either positive or negative. The case of the citizen reducing his energy useage and being charged higher rates is a case of positive feedback. The predicted behavior would be more reduction, followed by higher rates. Inverse or negative feedback may be more appropriate for social systems as proposed by Page.

Page tells the story of Thomas Edison and his first generating plant. Edison's first generating plant had two generators. When he turned the system on, one generator slowed down, the other speeded up. However, both generators were supposed to carry an equal load. They were identical generators but one was slightly more efficient than the other. The system was designed with <u>positive feedback</u>. The more efficient generator was reacting to the extra set of windings which were connected so that as the demand on the generator grew, its output voltage rose to compensate for higher transmission losses. This was positive feedback. The greater the load, the higher the voltage, which made the load appear still greater. The positive feedback in the design caused the more efficient generator to increase its voltage and output while the second generator dropped some of its load. Soon the first generator was overloaded and slowed down, the unloaded generator then speeded up and

began to run away. Edison first tried to shift the load manually but finally resorted to heavy flywheels and gears. The system was operating with positive feedback and was then unstable.

The solution was inverse or negative feedback. The extra windings on one generator should derive their power from the output of the other. Then, if the first generator picks up more load it signals the other to pick up more of its share. The system is then perfectly balanced and stable. The system works just as well with 3, 4 or any number of generators. (Page, p. 46)

There are other systems where inverse feedback would balance the system. Transportation is one example. The transportation system today, government regulations excepted, operates on positive feedback. Presently highway users pay taxes which become part of a highway trust fund which is used to build more highways for more cars. The result is less and less public mass transit because of fewer and fewer riders for the mass transit system and therefore less and less money to build and operate mass transit. The system is out of balance. Balance can be attained by using inverse feedback. Each part of the nation's transportation system receives its signal from another part just as the generator did. In terms of transportation higher income from automobiles would be used to increase mass transit. As mass transit systems improved their revenues would be used to improve air

transpo.tation which would in turn contribute to rail transit systems which would in turn contribute to the improvement of highway systems. (Page, p. 46)

Similar designs could be developed for equalizing educational opportunities and for developing various public services within a community.

Another system with some potential of aiding in the control of the social and technological systems has been proposed by Wagar (p. 1182) Wagar suggests that decisions be based on a Quality of Life Index rather than a Standard of Living Index. By using his system, there would be a continual evaluation of the effect decisions had on one's quality of life. The standard of living index is based on the theory that living improves as the per capita share of material goods increases either by increasing production or by decreasing losses or a combination of both. The formula is:

$$SL = \frac{\Sigma \text{ Production} - \Sigma \text{losses}}{\text{Population}}$$

The Quality of Life Index places a value not only on material goods but also a value on the quality and quantity of both services and experiences available to each person. Thus the environment becomes a factor in decision making. If the environment deteriorates, fewer opportunities are

available for quality experiences or services are reduced. The formula is:

$$QL = \frac{\Sigma \text{ Production} - \Sigma \text{ losses}}{\text{Population}} + \frac{\text{Services/Time}}{\text{Population}} + \frac{\text{Experiences/Time}}{\text{Population}}$$

The Redesign of Technology

In the past one dictum about technology was, "Whatever can be will be." This no longer holds true. People have discovered they can, in some measure, determine what happens to their lives. They have found they can alter the course of technological development. Witness the SST, Project Sanguine and certain highway and marine terminals. There is a danger, however, in stopping all technological development. Many technological developments have had positive effects on enhancing mankind. The fact is that while some technological developments have promoted impersonal efficiency-minded mass-production society, other technologies have been and are essential for a humane society. The problem seems to be more the way the technology has been implemented, (the organization of the workplace) and the amount of technology (growth) rather than anything else. In many instances technology has eliminated the routine, repetitive jobs from the workplace.

What needs to be remembered as we examine the problems associated with creating a more humane world is that new technological development can contribute to the solution of

societal problems. In fact, as has been pointed out previously, technology can contribute solutions and aid humankind in making progress where nontechnological attempts have failed. The use of computer models to simulate complex social and technological systems is one example. (Forrester) Negative feedback is another. (Page) Instruments designed to obtain information on the quality of the environment assist in decision making, as does the development of electrostatic precipitators and other technical solutions for the solution of air quality problems.

Deciding to correct a problem is one thing. Having people educated about technology and technological systems who can design solutions is another. Without the possibility of a solution, identifying the problem and deciding something should be done is an operation in futility.

Other examples of technological solutions to human problems which enhance the quality of human life include thermography, now used to detect breast tumors. Thermography is a heat picture. A Thermograph of a tumor shows the extra heat generated by a growth in contrast to the surrounding tissue. (Collier, p. 132)

Opaque 2, a new corn with nearly double the effective protein content of normal corn, nearly as much as meat and greater than milk, has been developed. It is predicted if the Opaque 2 gene can be transferred to the world's corn crop, it will be like adding ten million tons of protein to the

world supply and could eliminate the typical malnutrition which exists in societies whose basic protein supply comes from corn. (Friggens, p. 144)

Technology also contributes to new knowledge about our environment through developments which came from the space effort.

Earth orbiting satellites are one example of a technology that has had and will continue to have tremendous impact on the quality of life on earth. Once again it is the familiar need for solving problems, namely, information. The Earth Resources Technology Satellite (ERTS) and the Nimbus weather satellites are prime examples. ERTS shows great promise for data gathering for such activities as inventorying crops to determine the world food supply, planning efficient land use, prospecting for natural resources (oil, minerals, water), monitoring pollution and preparing new maps for census taking.

Nimbus satellites have aided immeasurably in weather monotoring and predicting, saving many lives and increasing the probability of better harvests.

The goal of a humane society meeting human needs and human purposes can be attained once people are educated about the system and its complex interrelationships and decide to alter technology and opt for a free society and a directed technology, rather than a free technology and a directed

society. By doing so, humankind will be using human ingenuity not only to control technology but to redirect and reconstruct the technological system. The goal is a controlled and directed technology rather than an uncontrolled random technology.

One example of this philosophy put into practice with the goal of enhancing the humaneness of life through the development and use of technology is intermediate technology, designed primarily for developing nations. It is a directed non-random effort. The intermediate technology effort is based on two assumptions with respect to using technology to raise the standard of living for the people of the world who live in conditions of poverty.

1. that in matters of development there is a problem of technology, of choosing the right "level of technology": in other words, that there is a <u>choice</u> of technology; that it cannot be assumed that what is best in conditions of affluence is necessarily best in conditions of poverty and

2. that the technologies most likely to be appropriate in conditions of great poverty would be in some sense "intermediate" between (to speak symbolically) the hoe and the tractor or the panga (broad bladed African knife) and the combine harvester. (McRobie, p. 109)

The goal of intermediate technology is to improve the life of people in developing countries by designing a technology and technological system they can afford. Intermediate technology, according to Cornish, can be used by everyone and is not reserved to those already rich. (Cornish, p. 279) Intermediate technology promises to help people become self-reliant, more productive and more independent by designing "appropriate" tools which Schumacher describes as neither primitive nor hopelessly sophisticated. (Schumacher, p. 43)

Implications for Industrial Arts Education

Whether technology has had an impact on industrial arts is an almost unanswerable question. Certainly there have been changes in the content and structure of industrial arts education throughout the country. In some places the scope and depth of the changes have been greater than others. Whether these changes are directly attributable to technology would be difficult to determine. However, we can be reasonably sure that the massive curriculum efforts of the 1960's which have continued into the 1970's were related in some way to technological change.

There are two ways to ask the question. One way is to ask what impacts there have been. The other question, and the one which is probably implied when the first one is

asked, is, "What impacts should there have been?"

The former question can be answered by the practitioners in the field through a comparative study of two time periods. The latter question and the answers are not the sole property of the practitioners. The second question can be answered by those concerned with American Public Education, namely all citizens.

If there was a forum of citizens appointed to study the question, "What Should Have Been the Impacts of Technology on Industrial Arts Education?" then perhaps we might discover some discontinuity between the professional educators and the citizens. The critical variable which affects the amount of discontinuity between and within each group would be the amount and level of information each group has about technology and technological systems.

In those programs of industrial arts where faculty are well informed about technology and technological systems, and the interrelatedness of these systems to social systems, the probability is high that the impact, as measured by the changes in the content, structure, scope and sequence of the curriculum, would be significantly greater than in those programs where faculty are less well informed.

If the decision of "What Should Have Been the Impact of Technology on Industrial Arts?" was placed with a group composed of well informed industrial arts faculty and well

informed lay people, we might find the following report a reasonably accurate perspective of their answer to the question.

There is an ever widening gap between that which should be taught about technology in the public schools and that which is taught. In many educational programs the study of technology is not a part of the curriculum, a curious omission in a society whose very basis is technology. We find many students, faculty and lay citizens totally oblivious of the tremendous effect decisions about technology and technological systems have on society and individuals within the society. There is a lack of both technological and social awareness.

One field of study, namely, industrial arts, has been attempting to organize its people to attack the problem. We recommend their efforts be encouraged and that their recommendation that the study of technology as a discipline be incorporated as part of the basic education of all youth in our society. This means that the field of industrial arts is to assume the responsibility for organizing, teaching and managing programs for the study of technology for all boys and girls at all levels of education. In a high technology society, governed by the democratic process, it is vital that each and every citizen be educated to participate fully and effectively in decisions regarding the quality of their life,

both in the immediate future and the long range future. This means that the study of technology and the behavior of technological systems must become an integral part of the basic education process.

Deciding questions about technology and the quality of life are complex interrelated issues all involving values and value judgements in addition to knowledge about the technical and social/cultural factors of the equation. Educating individuals to function effectively within these highly complex situations will require a long period of education.

In an earlier day when the goals of education and industrial arts education concerned simpler issues, it was possible to entertain the possibility of meeting these goals with minimal programs during the early secondary years. Not so today! The mission is too complex and too important to be limited to present time frames. We recommended that the field of industrial arts design a program for the study of technology ranging from kindergarten through grade 12. In addition we recommend that consideration be given to the question of continuing and adult education in other than traditional form and delivery.

These new programs for the public schools should be initiated as soon as possible. This will call for a complete redesign of teacher education programs and a massive

reeducation of teachers already in service. Consideration should be given to topics similar to the following in the design of the new programs of study. Creation of a new knowledge base incorporating the study of humankind, other cultures, systems, and the behavior of systems, decision making processes, change processes, the history and development of technology, goals and values in human societies, control of systems both technical and social, new technologies and technological systems including power and energy systems, transportation systems, communication systems and production systems, alternative technologies and the design of new technologies and new social and technical skills, among others.

In addition to the development of new curricula for the public schools, teacher education and teachers inservice, based on the study of technology, it will be necessary to design new instructional strategies based on the most current research on the communication process, the learning process and instructional technologies.

What seems to be needed to carry out the tasks is a regeneration of the field, a massive reeducation of all practitioners in the field if any real contribution by the field of industrial arts to the education of youth for a future in a technological society is to take place. What is needed is new knowledge. New levels of awareness. New sensitiveness about man, about society, about technology and about the role of industrial arts in contributing to

the education of individuals toward a more humane future.

In our study of the basic problem of technology education, we became acquainted with the history of industrial arts and found a number of our recommendations are not new. One couldn't help but wonder what the present contributions of industrial arts to education would have been had the field, during the past thirty years, actually pursued the study of technology, rather than focused attention on a number of diverse programs such as pre-vocational programs, crafts programs, manipulative skill programs, and occupations and the world of work programs? Certainly the study of technology will contribute to each of these issues but none should be an only theme for industrial arts. What if during these years work had been carried on in the study of technology and technological systems and the interrelationship of the systems? What if during these years focus had been on basic education in the technologies and the design and evaluation of technology for the home, the community, the social system? What if the field had focused on the study of work, not from the standpoint of preparing for a job, but from the standpoint of work and its importance to man? What if the field had focused on the design and redesign of technology to enhance work as a means of enhancing human beings? What if the practitioners of the field would have focused the study of technology on the future and the span of civilization rather than on the past and to some extent

the contemporary present? Is it possible our citizens would have made other choices about the type and rate of development of technology? Is it possible that alternative forms of technology would have been developed; that systems of control would have been created that would provide stability rather than instability?

If we believe in the potential of education as a creator of intelligent capable beings, then we would necessarily answer in the affirmative. Yes, today would have been different had the educational system included in its concern the study of one of man's most creative endeavors, technology. But it hasn't, therefore it must be concluded that the impact of technology on education and vice versa has been nil.

Perhaps it is not too late for educators to take a stand and opt for a more stable and humane future. Unfortunately the track record of educators as change agents has been, with few exceptions, of limited impact. Generally the significant changes in institutions, in disciplines, and various fields of endeavor have usually been made by people outside the institutions or disciplines or by the young or by those new to the discipline.

Thus if we desire to make an impact on education and the future of society we must solicit the assistance of those with a new perspective, those outside the discipline, the young and those new to the discipline. That is the story, the rest is commentary.

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